2018

Thanksgiving in Quarantine

Robin Bartlett

Thanksgiving in Quarantine

Robin Bartlett

When the United States defeated the Soviet Union in the much-anticipated and media-covered "Space Race," celebration immediately broke out nationwide. After the world observed the grainy, black and white broadcast of the astronauts landing on the Moon, and after Armstrong and Aldrin finished their test on the surface, the astronauts headed home. While many may assume they were swarmed by reporters and their families and friends upon their return, the astronauts were not stretching their legs or roaming freely on Earth following their homecoming. Upon splashing into the Pacific Ocean after nine days in space, the astronauts were ready to head to the Apollo Lunar Quarantine Program.[1]

The Apollo Lunar Quarantine Program (ALQ) first came to life in 1960, when the Space Science Board of the National Academy of Sciences advised NASA to create a committee on interplanetary quarantine.[1] One of the motives for the project was to protect Earth from any possible outside organism or bacteria that could have negative effects on Earth's environment, including humans. In addition, the ALQ was also concerned with protecting the Moon from humans. While the project would prove to be expensive, risking harm to Earth was a serious matter, and chief scientists and executives alike knew that they had a moral obligation to prevent contamination of Earth.[2] The keystone of the ALQ program was the Lunar Receiving Laboratory, where both astronauts and Moon samples were tested upon return, and quarantined. It was almost like being cramped in a small spaceship for another three weeks, but not flying anywhere.

After taking off from Earth, Apollo 11 was heading off on one of the most historic space expeditions of all time. While quarantine may be associated with only the return of the spacecraft, the quarantine process actually began as soon as Apollo 11 took off. Scientists and politicians established a moral and logistical code of conduct, with an emphasis on the importance of respecting the current state of the Moon as well as protecting the Earth.[6] Specific measures were taken to make sure that humans did not harm the Moon while gathering samples. Some of these measures included the astronauts making sure to kick off Moon dust and leave behind as little as possible, along with the large springs in the legs of the Apollo 11 vessel. These springs were designed for a safe landing, but also made sure that the spacecraft did not harm the Moon's surface.[9] Additionally, special chambers were located on the Apollo 11 to hold waste products until they could be disposed of back on Earth.[4]

Having completed the investigation on the Moon, Apollo 11 began its journey back to Earth. Apollo 11 was first retrieved by the USS Hornet in the Pacific Ocean.[3] Upon being recovered from the ocean, the astronauts, lunar samples, and aircraft were immediately isolated. The crew and equipment were first placed into the Mobile Quarantine Facility (MQF) and were joined by a crew surgeon and recovery engineer. The engineer and surgeon remained with them throughout the quarantine process. Quarantine was assured in the MQF by maintaining negative internal pressure and filtering the effluent air.[4] In similar fashion to the scientist working in a highly quarantined facility in the book *The Andromeda Strain*, biological isolation garments Apollo astronauts wore biological isolation garments to separate themselves from Earth's environment and recovery crew.[5] The suit was constructed of nylon and had a built-in air-inlet

flapper that biologically filtered expired gas. In order to avoid any interaction with Earth's environment, the crew put on the suit inside of the Apollo craft and wore it until they were inside the MQF.[4]

The responsibilities of the crew did not end when they landed; their quarantine process was only beginning. The Apollo crew members were required to stay in the LRL for three weeks because it had been determined that most terrestrial diseases were able to invade a host and show signs of symptoms within twenty-one days.[7] The LRL was biologically contained by two main systems, a primary and secondary barrier. The primary barrier was made up of Class III biological cabinets and a vacuum complex, ensuring that outside air was not interacting with the LRL. The secondary barrier was maintained in the sample labs and crew reception area by keeping the areas at a negative pressure relative to the atmospheric pressure outside the building.[8]

In many ways, the quarantine process was as labor-intensive as getting the astronauts to space. The process of quarantine for the crew members of the Apollo missions and samples brought back from the Moon included five main objectives: crew safety, biological isolation, sustenance provisioning, medical debriefing provisions, and safe transportation. Crew safety was focused on providing a secure method of retrieval of the crew and spacecraft. Biological isolation was focused on isolating astronauts and materials during the recovery operation and during the movement of the crew and equipment from the recovery area to the LRL. Sustenance provisioning involved monitoring the crews eating and sleeping patterns, and that the hygienic facilities for the crew and technical personnel during the return phase were secure. Medical and debriefing provisioning were focused on providing medical facilities during the recovery and transportation phases. Finally, transportation was focused on providing suitable hardware for the transportation of the crew and hardware by ship, aircraft, and truck.[9] These procedures contributed to the quarantine and safety of the planet, crew members, and samples.

One of the largest areas of concern was the health of the astronauts who had been exposed to space. Once the Apollo astronauts were safely transported into the LRL along with the added surgeon and technician, the examinations began. During the period of quarantine, the crew and their immediate contacts went through daily medical examinations. Some of the more basic operations included the recording of oral temperature and pulse rate and a brief interview with the crew surgeon. On the twelfth and eighteenth days after arrival, biological specimens were obtained from the crew, and on the twenty-first day, they underwent another complete physical examination. Aside from the scheduled tests, selected immunological and microbiological examinations were conducted at several points in the quarantine. The purpose of these examinations was to implement more complete diagnostic information in the event of clinical illness.[10]

No component of the mission was left overlooked in the quarantine protocol; the flight equipment that was exposed to lunar surface material was also placed under quarantine restrictions. To ensure that the equipment was not carrying anything that could be harmful to Earth's environment, the equipment had to be thoroughly sterilized. This equipment included film, data tapes, logs, etc. Film from the Apollo 11 mission was sterilized with ethylene oxide. However, after the Apollo 11 mission, sterilization of flight film was no longer required because tests showed that the film was not dangerous. Data tapes were received in the CRA and were

sterilized using ethylene oxide gas and passed through the biological barrier so they could be saved and copied.[15]

NASA was heavily invested in quarantining and preserving the samples of lunar material that had been recovered by Apollo 11. Containers that held samples of lunar rocks and soil were opened in a unique vacuum chamber that mimicked lunar pressure. This chamber was designed to protect the sterility of the samples and guaranteed that the samples were preserved without being exposed to Earth's atmosphere.[6]

Regarding the analysis of lunar materials, it was a much more extensive process than the quarantine of the astronauts. Upon arriving at the Lunar Receiving Laboratory, the sample containers were put through an airlock and three decontamination chambers to sterilize the outside of the containers. Following the initial decontamination, the boxes were placed into a vacuum chamber. In the chamber, a technician punctured a diaphragm to draw off any gases. Then, the samples were passed on to a mass spectrometer to determine if Earth's atmosphere had contaminated the inside and if any gases could be identified as being of lunar origin.[11] The exact pressures inside of the vacuum chambers differed. One sample room was kept at exactly 1.33 x 10-4 N/m2 (10-6 mm Hg). The other chamber had an atmosphere of sterile nitrogen at a pressure slightly below atmospheric.[12] Each lunar sample was then thoroughly examined, photographed from six different angles, and observed through microscopes. Small chips of each rock were examined with the goal of determining physical and chemical properties.[13]

Upon examining the quarantine protocol used by the LRL, it becomes clear that the biological safety of all life forms was of paramount importance. Certain portions of the lunar samples were tested for mycology, bacteriology, virology-mycoplasma, mammalian animals, botanical systems, and invertebrate/lower vertebrate systems. In order to sterilize these samples, dry heat was applied to them during the quarantine period.[14] These tests were critical for determining whether there was any sign of organisms on the Moon.

In addition to simple observation, biomedical experimentation was used to determine the effects of lunar material on living organisms. Representative samples of lunar material were studied to see if they contained any microorganisms and then assessed to make certain they were nonhazardous. A series of experiments were conducted on different plants and animals by exposing them to lunar material via small injections. The tests were conducted on forty plants and fifteen animals. It was found that the test subjects showed no ill effects or adverse conditions as a result of exposure to the samples.[16]

The process of biological protection in both *The Andromeda Strain* and The Lunar Quarantine Program share a resolute commitment to protecting the barriers between Earth and space. Primarily, both protocols took measures that were not entirely necessary. In *The Andromeda Strain*, the scientists were never being exposed to the materials they were examining, yet they still wore airtight suits to interact with Andromeda. While this could have been a plot hole, it does draw a parallel to excessive measures taken in the LQP as well. Following the first few Apollo missions, the LQP was significantly altered. Exhaustive studies of the astronauts and lunar samples from Apollo 11 and 12 indicated there were no hazards to Earth's biosphere. Thus, the Interagency Committee on Back-Contamination in January of 1970, concurred in NASA's recommendation that stringent quarantine rules be abandoned for future Apollo missions to the Moon.[17] Both of these processes, one fictional, and one real, were examining humans' first interaction with materials from space. The precautions that were taken in both instances are

justifiable, as it is possible that substances coming from outer space could have adverse effects on Earth's environment.

While the Moon has been deemed sterile, the next human ventures to space seem to be more ambitious. The private space sector led by SpaceX has determined that the next frontier is to send a man to Mars. Studies have supported Mars having an atmosphere in the past, and scientists also know there is a frozen sea on Mars. Due to Mars's possible ability to support life, measures similar to the LQP will be taken when humans first return from Mars. The Mars Quarantine Program will practice extreme caution and meticulous procedures until scientists have determined the likelihood of anything from Mars being a threat to Earth. For now, science fiction novels like *The Andromeda Strain* will be our only glimpse of a possible biological disaster originating from a space object, and programs like the LQP will continue to safeguard our planet.

Bibliography

Minutes, meeting of the Exobiology Committee of the Space Science Board, Feb. 20, 1960, cited in Space Science Board, "Conference on Potential Hazards of Back Contamination from the Planets, July 29- 30, 1964" (advance copy), no date [Aug. 1964].

Owen E. Maynard to PS Branches, "Earth contamination from lunar surface organisms," Oct. 29, 1965.

Loff, Sarah. “Apollo 11 Mission Overview.” NASA, NASA, 17 Apr. 2015, www.nasa.gov/mission_pages/apollo/missions/apollo11.html.

Mcollum, Bogard. “Apollo Lunar Qaurantine Program.” Nasa.gov, 21 Mar. 2013, www.jsc.nasa.gov/history/oral_histories/McCollumGW_BogardD/ApolloLQP.pdf.

Crichton, Michael. The Andromeda Strain. Vintage Books, 2017.

Elbert A. King, “Lunar Receiving Labratory.” Moon Trip: a Personal Account of the Apollo Program and Its Science, University of Houston, 1989, pp. 59–72.

Baarlen, van, et al. “Molecular Mechanisms of Pathogenicity: How Do Pathogenic Microorganisms Develop Cross-Kingdom Host Jumps? | FEMS Microbiology Reviews | Oxford Academic.” OUP Academic, Oxford University Press, 1 Apr. 2007, academic.oup.com/femsre/article/31/3/239/2367343.

Allton, Judy. “Evolution of the Lunar Receiving Laboratory to Astromaterial Sample Curation Facility: Technical Tensions Between Containment and Cleanliness, Between Particulate and Organic Cleanliness.” Nasa.gov, Apr. 2016, ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20160006649.pdf.

Meltzer, Michael. “When Biospheres Collide: A History of NASA's Planetary Protection Program.” Nasa.gov, 2011, www.nasa.gov/pdf/607072main_WhenBiospheresCollide-ebook.pdf.

Brooks, Geo. “Health Surveillance of Lunar Receiving Laboratory Personnel During Apollo 11 Quarantine period.” American Public Health Association, 1970, https://ajph.aphapublications.org/doi/pdf/10.2105/AJPH.60.10.1956.

1211-1227, Science19 Sep 1969: “Preliminary Examination of Lunar Samples from Apollo 11.” Science, American Association for the Advancement of Science, 19 Sept. 1969, science.sciencemag.org/content/165/3899/1211.

McLane, James C., et al. “Lunar Receiving Laboratory.” Science, vol. 155, no. 3762, 1967, pp. 525–529. JSTOR, JSTOR, www.jstor.org/stable/1720378.

Korotev, Randy L. “Concentrations of Radioactive Elements in Lunar Materials.” Journal of Geophysical Research: Planets, vol. 103, no. E1, 1998, pp. 1691–1701. doi:10.1029/97je03267.

“Geological Investigations in Early Apollo Missions.” Scientific and Technical Information Division, National Aeronautics and Space Administration, NASA 1965 Summer Conference on Lunar Exploration and Science; 1965, pp. 91–114.

"WebWISER - Substance Data." U.S. National Library of Medicine, National Institutes of Health, 2012, webwiser.nlm.nih.gov/getSubstanceData.do?substanceId=52&displaySubstanceName=E%2BO&STCCID=&UNNAID=&selectedDataMenuItemID=22&catId=24.

Taylor, Gerad. "QUARANTINE TESTING AND BIOCHARACTERIZATION OF LUNAR MATERIALS." NASA, NASA, 1975, history.nasa.gov/SP-368/s5ch2.htm.